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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/828,959	04/21/2004	Kethinni G. Chittibabu	08688-048002	5392
26161	7590	12/16/2004	EXAMINER	
FISH & RICHARDSON PC 225 FRANKLIN ST BOSTON, MA 02110			DIAMOND, ALAN D	
			ART UNIT	PAPER NUMBER

1753

DATE MAILED: 12/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/828,959

Applicant(s)

CHITTIBABU ET AL.

Examiner

Alan Diamond

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 April 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 and 43-58 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-26 and 43-58 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>04/21/04, 10/06/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Comments

1. The preliminary amendment to the claims filed 04/21/04 did not accurately amend the claims. Claim 43, as it was originally filed (as an independent claim), is missing from said preliminary amendment. Said preliminary amendment does present a claim 43, but it should be noted that claims 43-57 in said preliminary amendment correspond to originally filed claims 44-58, respectively. Claim 58 in said preliminary amendment is a duplicate of claim 57 in said preliminary amendment, and thus, the total number of claims in said preliminary amendment is the same as in the same originally filed claims. Claim 59 in said preliminary amendment is appropriately canceled since it was an originally filed device (photovoltaic cell) claim. The Examiner has examined claims 1-26 and 43-58 as they are presented in said preliminary amendment.

Claim Objections

2. Claims 5 and 9 are objected to because of the following informalities: In claim 5 at line 1, and in claim 9 at line 2, the word "a" should be changed to "the" so as to use proper Markush language. Appropriate correction is required.

3. Claim 58 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 58 presents the exact said limitation as parent claim 57.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 43-50 and 52-58 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 43 is indefinite because it depends from itself. The same applies to dependent claims 44, 46, and 48-50.

Claim 44 is indefinite because "the first electrode" at lines 1-2 lacks positive antecedent support in claim 43.

Claim 45 is indefinite because it depends from itself.

Claim 46 is indefinite because "the first electrode" at line 2 lacks positive antecedent support in claim 43.

Claim 47 is indefinite because it depends from itself.

Claim 48 is indefinite because "the second substrate" lacks positive antecedent support in claim 43.

Claim 49 is indefinite because "step (b)" at line 1 and "the second substrate" at line 2 lack positive antecedent support in claim 43.

Claim 52 is indefinite because it depends from itself. The same applies to dependent claims 54 and 55.

Claim 53 is indefinite because it depends from itself.

Claim 55 is indefinite because it is not clear where the second electrode is formed or where it is to be located.

Claim 56 is indefinite because it depends from itself.

Claim 57 is indefinite because it depends from itself. The same applies to dependent claim 58.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1, 3, 4, 6, 7, 12-14, 43, 45, and 49 are rejected under 35 U.S.C. 102(b) as being anticipated by Maruyama et al, EP 993050 A2.

As seen in Figure 4, Maruyama et al prepares a photoelectric conversion device comprising semiconductor substrate (1), i.e., instant first substrate; crosslinked semiconductor particles (2-1, 2-2, 2-3) that are crosslinked at connection points (4-1, 4-2, 4-3); and semiconductor layer (6) and electrode (10-1) which together read on the instant second substrate, wherein said semiconductor layer (6) and electrode (10-1) are electrically connected to said semiconductor substrate (1) (see also paragraphs 0029, 0035, 0036, 0040, 0046, and 0063). As seen in said Figure 4, said semiconductor particles are between said first and second substrates. Said semiconductor particles

read on both the instant semiconductor particles and the instant cross-linking agent. When the semiconductor particles are placed on the substrate they are contacted with each other, and thus, the instant step of contacting a cross-linking agent with semiconductor particles is obtained; and this step is subsequently followed by a heating or film bonding step to interconnect, i.e., cross-link the particles (see paragraphs 0035 and 0072; and claims 6-9 at cols. 20-21). Thus, the interconnection can be made of the same material as the particles themselves. The particles can be made from, for example, GaAs (paragraph 0078). GaAs has a metal to non-metal bond, as per claim 7. Said semiconductor layer (6) reads on the catalyst in instant claim 49. Since Maruyama et al teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

8. Claims 1, 3-8, 11-24, 43-46, and 48-50 are rejected under 35 U.S.C. 102(e) as being anticipated by Nakamura, U.S. Patent 6,291,763.

Nakamura prepares a photovoltaic cell by providing TiO₂ semiconductor particles on a substrate and firing (heating) the particles, and thus cross-linking the particles (see col. 5, lines 1-35; col. 7, lines 42-57; and Examples 1 and 2). In other words, TiO₂ semiconductor particles read on both the instant semiconductor particles and the instant cross-linking agent. The TiO₂ particles are thus, contacted with each other and then fired, as in instant claim 45.

With respect to claims 3-8, the interconnection of the particles is with the same material as the particles themselves, i.e., TiO₂, and the TiO₂ contains a metal to non-metal bond, i.e., a bond of Ti metal to O non-metal.

With respect to claims 11 and 50, a dye can be applied to the semiconductor particles (see col. 7, line 66 through col. 8, line 29; and col. 33, line 66).

With respect to claims 12-14, see Figure 1 and Example 1 of Nakamura which show the instant substrates.

With respect to claims 15-18, 20-23, and 48 Nakamura's substrates can be flexible and transparent, and made from polymers such as polyethylene terephthalate, polyethylene naphthalate, or polyether-imide (which reads on the instant polyimide) (see col. 6, lines 4-21; and col. 14, lines 44-65).

With respect to claims 19 and 44, the firing of the semiconductor particles can be at 100°C to 600°C, the 100°C being anticipatory of the instantly temperature (see col. 7, lines 42-47). Indeed, note Example 2 at col. 35 uses a temperature of 300°C.

With respect to claims 24 and 46, the photovoltaic cell further comprises a gelled electrolyte solution that includes the combination of I₂ and an iodide salt in a solvent, such as ethylene carbonate, propylene carbonate, etc, and a gelling agent such as polyacrylonitrile, polyvinylidene fluoride, etc (thus forming a polymeric polyelectrolyte has here claimed) (see col. 25, lines 21-65; and col. 26, lines 16-32).

With respect to claim 49, Nakamura forms a Pt layer (6) which reads on the instant catalyst layer (see col. 34, line 21; and Figure 1).

Since Nakamura teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

9. Claims 1, 3-8, 11-14, 24, 43, 45-47, 49, and 50 are rejected under 35 U.S.C. 102(b) as being anticipated by Cao et al, "A Solid State Sensitized Photoelectrochemical Cell," J. Phys. Chem., vol. 99, pages 17071-17073, (1995).

Cao et al prepares a dye sensitized photoelectrochemical cell by providing TiO₂ semiconductor particles on a substrate and firing (heating) the particles, and thus cross-linking the particles (see the Experimental section at page 17071). In other words, TiO₂ semiconductor particles react on both the instant semiconductor particles and the instant cross-linking agent. The TiO₂ particles are thus, contacted with each other and then fired, as in instant claim 45.

With respect to claims 3-8, the interconnection of the particles is with the same material as the particles themselves, i.e., TiO₂, and the TiO₂ contains a metal to non-metal bond, i.e., a bond of Ti metal to O non-metal.

With respect to claims 11 and 50, a dye is applied to the semiconductor particles (see the Experimental section at page 17071).

With respect to claims 12-14, Cao et al's photoelectrochemical cell comprises an ITO-coated glass substrate (instant first substrate) having the sintered TiO₂ particle semiconductor thereon, and an ITO counter electrode (second substrate) electrically connected to said ITO-coated glass substrate (see the Experimental section at page 17071).

With respect to claims 24, 46, and 47, the cell further contains a gel electrolyte that is a polymeric electrolyte comprising 1.4 g of polyacrylonitrile (PAN), 10 g of ethylene carbonate, 5 mL of propylene carbonate, 5 mL of acetonitrile, 1.5 g of NaI, and

0.1 g of I₂ (see the Experimental Section). The ethylene carbonate, propylene carbonate, and acetonitrile together read on the instant plasticizer. The NaI/I₂ reads on the instant redox electrolyte. Since the densities of propylene carbonate and acetonitrile are 1.2 g/mL and 0.79 g/mL respectively, then there are 6 g of propylene carbonate and 3.95 g of acetonitrile. Thus, based on the total weight of polymer and plasticizer, there is 6.6% PAN and 93.4% plasticizer. The 1.5 g of NaI plus 0.1 g of I₂ in the 10 g ethylene carbonate, 5 mL propylene carbonate, and 5mL acetonitrile is within the instant range of 0.5M to about 10M of redox electrolyte.

With respect to claim 49, Nakamura has a formed Pt coating which reads on the instant catalyst layer (see page 17071, second column).

Since Cao et al teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

10. Claims 1-25, 43-46, and 48-50 are rejected under 35 U.S.C. 102(a) as being anticipated by Koyanagi et al, WO 01/03232. The instant rejection is under 102(a) because instant provisional application 60/298,858, which has a filing date of 06/15/2001, fully supports the instantly claimed subject matter. Koyanagi et al has a 102(a) publication date of 01/11/2001.

With respect to claims 1, 25, and 43, Koyanagi et al prepares a photoelectric cell by providing TiO₂ semiconductor particles, contacting them with titanium acetylacetonatoalkoxide so as to form shells on the particles, and then binding the core/shell particles together by contacting them with peroxotitanic acid solution (see pages 79-80; and production example 2 and Example 21 at pages 116-123). In another

Example, the particles do not have a shell but are still contacted with the peroxotitanic acid (see the other Example 21 at pages 112-113). The titanium acetylacetonatoalkoxide along with the peroxotitanic acid read on the instant cross-linking agent, or the peroxotitanic acid itself reads on the instant cross-linking agent.

With respect to claims 2, 9, 10, and 25, said titanium acetylacetonatoalkoxide is organometallic, it is a metal alkoxide, and it is a sol gel precursor. Furthermore, the peroxotitanic acid is also a sol gel precursor.

With respect to claims 3-8, the titanium acetylacetonatoalkoxide, along with the peroxotitanic acid will result in metal-oxygen bond, i.e., the same bond as in the TiO_2 .

With respect to claims 11, 25, and 50, a dye is applied to the semiconductor particles (see the Example 21 at pages 122-123).

With respect to claims 12-18, 20-23, 25, and 48, in said Example 21 at pages 122-123, the semiconductor particles are disposed on a first (glass) substrate, and the a second (glass) substrate is placed over the semiconductor particles so as to electrically connect said first and second substrates. In place of glass, the other Example 21 at pages 112-113, uses polyimide and polyethylene terephthalate substrates. With respect to instant claims 12-18, it does not make a difference which of the polyimide and polyethylene terephthalate substrates is considered a first or second substrate because Koyanagi et al's TiO_2 particles can be disposed on either of the substrates. Koyanagi et al's device can be flexible and thin (page 5), and a flexible device will result when said polyimide and polyethylene terephthalate are used as the substrates.

With respect to claims 19, 44, and 45, after the particles have been contacted with the peroxotitanic acid or after have been contacted with the titanium acetylacetonatoalkoxide to form the shell and then the peroxotitanic acid, the first substrate is then heated to 350°C in the Example 21 at pages 112-113, or to 300°C in the Example 21 at pages 122-123.

With respect to claims 24, 25, and 46, a "polymeric electrolyte" or "polyelectrolyte" can be incorporated in the cell since the electrolyte added to the cell can be one which contains a polymer-dispersed liquid crystal (see page 36).

With respect to claim 49, a Pt catalyst can be formed on the second substrate (see the Examples 21 at pages 112-113 and 122-123).

Since Koyanagi et al teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

12. Claims 1, 3-8, 11-24, 26, 43-46, 48-50, and 51-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura, U.S. Patent 6,291,763, in view of Hoffmann et al, U.S. Patent 5,830,597.

Nakamura prepares a photovoltaic cell by providing TiO₂ semiconductor particles on a substrate and firing (heating) the particles, and thus cross-linking the particles (see

col. 5, lines 1-35; col. 7, lines 42-57; and Examples 1 and 2). In other words, TiO₂ semiconductor particles read on both the instant semiconductor particles and the instant cross-linking agent. The TiO₂ particles are thus, contacted with each other and then fired, as in instant claim 45.

With respect to claims 3-8, the interconnection of the particles is with the same material as the particles themselves, i.e., TiO₂, and the TiO₂ contains a metal to non-metal bond, i.e., a bond of Ti metal to O non-metal.

With respect to claims 11, 50, and 54, a dye can be applied to the semiconductor particles (see col. 7, line 66 through col. 8, line 29; and col. 33, line 66).

With respect to claims 12-14, see Figure 1 and Example 1 of Nakamura which show the instant substrates.

With respect to claims 15-18, 20-23, 48, 26, and 51, Nakamura's substrates can be flexible and transparent, and made from polymers such as polyethylene terephthalate, polyethylene naphthalate, or polyether-imide (which reads on the instant polyimide) (see col. 6, lines 4-21; and col. 14, lines 44-65).

With respect to claims 19, 44, and 53, the firing of the semiconductor particles can be at 100°C to 600°C, the 100°C being anticipatory of the instant temperature (see col. 7, lines 42-47). Indeed, note Example 2 at col. 35 uses a temperature of 300°C.

With respect to claims 24 and 46, the photovoltaic cell further comprises a gelled electrolyte solution that includes the combination of I₂ and an iodide salt in a solvent, such as ethylene carbonate, propylene carbonate, etc, and a gelling agent such as

polyacrylonitrile, polyvinylidene fluoride, etc (thus forming a polymeric polyelectrolyte has here claimed) (see col. 25, lines 21-65; and col. 26, lines 16-32).

With respect to claims 49 and 55, Nakamura forms a Pt layer (6) which reads on the instant catalyst layer (see col. 34, line 21; and Figure 1).

Nakamura teaches the limitations of the instant claims other than the difference which is discussed below.

With respect to claims 26 and 51-58, Nakamura does not specifically teach a continuous process for preparing its photovoltaic cell. However, the use of continuous processing is well known in the art, as shown in Figure 2 of Hoffmann et al (see also col. 4, line 18 through col. 5, line 52). In Hoffmann et al's process, the TiO₂ (8), dye (9), and electrolyte layer (10) are disposed on a first substrate (5) in a continuous process (see said Figure 2; and col. 4, lines 30-62). The second substrate (6) can be provided with the electrically conductive layer (11) (see col. 4, lines 36-40). Hoffmann et al's method provides the advantage of producing a photovoltaic cell at low cost and with reproducibility (see col. 1, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Nakamura's photovoltaic cell using continuous processing because such processing is conventional in the art, as shown by Hoffmann et al, and provides the advantage of producing a photovoltaic cell at low cost and with reproducibility, as taught by Hoffmann et al. While Hoffmann et al does not specifically teach the Pt catalyst layer in instant claim 26, this layer, as noted above, is taught by Nakamura. A skilled artisan clearly would have provided this Pt layer in addition to a conductive layer on Nakamura's second substrate.

13. Claims 1-26, 43-46, and 48-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koyanagi et al, WO 01/03232, in view of Hoffmann et al, U.S. Patent 5,830,597.

With respect to claims 1, 25, and 43, Koyanagi et al prepares a photoelectric cell by providing TiO₂ semiconductor particles, contacting them with titanium acetylacetonatoalkoxide so as to form shells on the particles, and then binding the core/shell particles together by contacting them with peroxotitanic acid solution (see pages 79-80; and production example 2 and Example 21 at pages 116-123). In another Example, the particles do not have a shell but are still contacted with the peroxotitanic acid (see the other Example 21 at pages 112-113). The titanium acetylacetonatoalkoxide along with the peroxotitanic acid read on the instant cross-linking agent, or the peroxotitanic acid itself reads on the instant cross-linking agent.

With respect to claims 2, 9, 10, and 25, said titanium acetylacetonatoalkoxide is organometallic, it is a metal alkoxide, and it is a sol gel precursor. Furthermore, the peroxotitanic acid is also a sol gel precursor.

With respect to claims 3-8, the titanium acetylacetonatoalkoxide, along with the peroxotitanic acid will result in metal-oxygen bond, i.e., the same bond as in the TiO₂.

With respect to claims 11, 25, 50, and 54, a dye is applied to the semiconductor particles (see the Example 21 at pages 122-123).

With respect to claims 12-18, 20-23, 25, 26 48, and 51 in said Example 21 at pages 122-123, the semiconductor particles are disposed on a first (glass) substrate, and the a second (glass) substrate is placed over the semiconductor particles so as to

electrically connect said first and second substrates. In place of glass, the other Example 21 at pages 112-113, uses polyimide and polyethylene terephthalate substrates. With respect to instant claims 12-18, it does not make a difference which of the polyimide and polyethylene terephthalate substrates is considered a first or second substrate because Koyanagi et al's TiO₂ particles are disposed on either of the substrates. Koyanagi et al's device can be flexible and thin (page 5), and a flexible device will result when said polyimide and polyethylene terephthalate are used as the substrates.

With respect to claims 19, 44, and 45, after the particles have been contacted with the peroxotitanic acid or after have been contacted with the titanium acetylacetonatoalkoxide to form the shell and then the peroxotitanic acid, the first substrate is then heated to 350°C in the Example 21 at pages 112-113, or to 300°C in the Example 21 at pages 122-123.

With respect to claims 24, 25, and 46, a "polymeric electrolyte" or "polyelectrolyte" can be incorporated in the cell since the electrolyte added to the cell can be one which contains a polymer-dispersed liquid crystal (see page 36).

With respect to claim 49, a Pt catalyst can be formed on the second substrate (see the Examples 21 at pages 112-113 and 122-123).

Koyanagi et al teaches the limitations of the instant claims other than the difference which is discussed below.

With respect to claims 26 and 51-58, Koyanagi et al does not specifically teach a continuous process for preparing its photovoltaic cell. However, the use of continuous

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processing is well known in the art, as shown in Figure 2 of Hoffmann et al (see also col. 4, line 18 through col. 5, line 52). In Hoffmann et al's process, the TiO₂ (8), dye (9), and electrolyte layer (10) are disposed on a first substrate (5) in a continuous process (see said Figure 2; and col. 4, lines 30-62). The second substrate (6) can be provided with the electrically conductive layer (11) (see col. 4, lines 36-40). Hoffmann et al's method provides the advantage of producing a photovoltaic cell at low cost and with reproducibility (see col. 1, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Koyanagi et al's photovoltaic cell using continuous processing because such processing is conventional in the art, as shown by Hoffmann et al, and provides the advantage of producing a photovoltaic cell at low cost and with reproducibility, as taught by Hoffmann et al. While Hoffmann et al does not specifically teach the Pt catalyst layer in instant claim 26, this layer, as noted above, is taught by Koyanagi et al. A skilled artisan clearly would have provided this Pt layer in addition to a conductive layer on Koyanagi et al's second substrate.

Double Patenting

14. A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101 which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

A statutory type (35 U.S.C. 101) double patenting rejection can be overcome by canceling or amending the conflicting claims so they are no longer coextensive in scope. The filing of a terminal disclaimer cannot overcome a double patenting rejection based upon 35 U.S.C. 101.

15. Claims 1-26 and 51-58 are provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claims 1-26 and 52-58 of copending Application No. 10/165,877. This is a provisional double patenting rejection since the conflicting claims have not in fact been patented.

16. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

17. Claims 43-50 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-26 and 43-58 of copending Application No. 10/165,877. Although the conflicting claims are not identical, they are not patentably distinct from each other because, although claims 1-26 and 43-58 are not of the same scope as instant claims 43-50, they anticipate instant claims 43-50.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

18. Claims 1-25, 43-46, and 48-50 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over

claims 1-15 of copending Application No. 10/351,260 in view of Nakamura, U.S. Patent 6,291,763.

The claims of said copending application teach the instantly claimed methods, the difference being that the claims of said copending application do not specifically teach forming the semiconductor oxide nanoparticle layer as part of a photovoltaic device.

Nakamura prepares a photovoltaic cell by providing TiO_2 semiconductor particles on a substrate and firing (heating) the particles, and thus cross-linking the particles (see col. 5, lines 1-35; col. 7, lines 42-57; and Examples 1 and 2). In other words, TiO_2 semiconductor particles read on both the instant semiconductor particles and the instant cross-linking agent. The TiO_2 particles are thus, contacted with each other and then fired, as in instant claim 45.

With respect to claims 3-8, the interconnection of the particles is with the same material as the particles themselves, i.e., TiO_2 , and the TiO_2 contains a metal to non-metal bond, i.e., a bond of Ti metal to O non-metal.

With respect to claims 11, 50, and 54, a dye can be applied to the semiconductor particles (see col. 7, line 66 through col. 8, line 29; and col. 33, line 66).

With respect to claims 12-14, see Figure 1 and Example 1 of Nakamura which show the instant substrates.

With respect to claims 15-18, 20-23, 48, 26, and 51, Nakamura's substrates can be flexible and transparent, and made from polymers such as polyethylene

terephthalate, polyethylene naphthalate, or polyether-imide (which reads on the instant polyimide) (see col. 6, lines 4-21; and col. 14, lines 44-65).

With respect to claims 19, 44, and 53, the firing of the semiconductor particles can be at 100°C to 600°C, the 100°C being anticipatory of the instant temperature (see col. 7, lines 42-47). Indeed, note Example 2 at col. 35 uses a temperature of 300°C.

With respect to claims 24 and 46, the photovoltaic cell further comprises a gelled electrolyte solution that includes the combination of I₂ and an iodide salt in a solvent, such as ethylene carbonate, propylene carbonate, etc, and a gelling agent such as polyacrylonitrile, polyvinylidene fluoride, etc (thus forming a polymeric polyelectrolyte has here claimed) (see col. 25, lines 21-65; and col. 26, lines 16-32).

With respect to claims 49 and 55, Nakamura forms a Pt layer (6) which reads on the instant catalyst layer (see col. 34, line 21; and Figure 1).

The advantage of preparing a photovoltaic device is that electricity can be generated, and Nakamura's structure provides the advantage of excellent conversion efficiency (see col. 2, lines 24-26). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared a photovoltaic cell, such as one having the structure of Nakamura, using the semiconductor oxide nanoparticle layer in the claims of said copending application because the advantage of preparing a photovoltaic device is that electricity can be generated, and Nakamura's structure provides the advantage of excellent conversion efficiency.

This is a provisional obviousness-type double patenting rejection.

19. Claim 47 is provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-15 of copending Application No. 10/351,260 in view of Nakamura as applied to claims 1-25, 43-46, and 48-50 above, and further in view of Cao et al, "A Solid State Sensitized Photoelectrochemical Cell," J. Phys. Chem., vol. 99, pages 17071-17073, (1995).

The claims of said copending application, in view of Nakamura, as relied upon for the reasons recited above, teach the limitations of claim 47, the difference being that neither the claims of said copending application nor Nakamura teaches the electrolyte composition in said claim 47. Nakamura teaches an electrolyte in its cell (see col. 25, line 18 through col. 27, line 36). Cao et al is relied upon for showing a photoelectrochemical cell employing a dye-sensitized, nanocrystalline TiO_2 electrode and an electrolyte (see page 17071). The electrolyte is prepared from 1.4 g of polyacrylonitrile (PAN), 10 g of ethylene carbonate, 5 mL of propylene carbonate, 5 mL of acetonitrile, 1.5 g of NaI, and 0.1 g of I_2 (see the Experimental section). The ethylene carbonate, propylene carbonate, and acetonitrile together read on the instant plasticizer. The NaI/ I_2 reads on the instant redox electrolyte. Since the densities of propylene carbonate and acetonitrile are 1.2 g/mL and 0.79 g/mL respectively, then there are 6 g of propylene carbonate and 3.95 g of acetonitrile. Thus, based on the total weight of polymer and plasticizer, there is 6.6% PAN and 93.4% plasticizer. The 1.5 g of NaI plus 0.1 g of I_2 in the 10 g ethylene carbonate, 5 mL propylene carbonate, and 5 mL acetonitrile is within the instant range of 0.5M to about 10M of redox electrolyte. It would have been obvious to one of ordinary skill in the art at the time the invention was

made to have used Cao et al's electrolyte in the claims of said copending application in view of Nakamura's photovoltaic cell because Nakamura specifically teaches that an electrolyte is be used, and Cao et al's electrolyte is an example thereof.

This is a provisional obviousness-type double patenting rejection.

20. Claims 26 and 51-58 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-15 of copending Application No. 10/351,260 in view of Nakamura as applied to claims 1-25, 43-46, and 48-50 above, and further in view of Hoffmann et al, U.S. Patent 5,830,597.

The claims of said copending application, in view of Nakamura, as relied upon the reasons recited above, teach the limitations of instant claims 26 and 51-58, the difference being that Nakamura does not specifically teaches a continuous process for preparing the photovoltaic cell. However, the use of continuous processing is well known in the art, as shown in Figure 2 of Hoffmann et al (see also col. 4, line 18 through col. 5, line 52). In Hoffmann et al's process, the TiO₂ (8), dye (9), and electrolyte layer (10) are disposed on a first substrate (5) in a continuous process (see said Figure 2; and col. 4, lines 30-62). The second substrate (6) can be provided with the electrically conductive layer (11) (see col. 4, lines 36-40). Hoffmann et al's method provides the advantage of producing a photovoltaic cell at low cost and with reproducibility (see col. 1, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared the photovoltaic cell of the claims of said copending application in view of Nakamura using continuous processing because such processing is conventional in the art, as shown by Hoffmann et al, and provides the

advantage of producing a photovoltaic cell at low cost and with reproducibility, as taught by Hoffmann et al. While Hoffmann et al does not specifically teach the Pt catalyst layer in instant claim 26, this layer, as noted above, is taught by Nakamura.

This is a provisional obviousness-type double patenting rejection

21. Claims 1-25, 43-46, and 48-50 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-19 of copending Application No. 10/918,493 in view of Nakamura, U.S. Patent 6,291,763.

The claims of said copending application teach the instantly claimed methods, the difference being that the claims of said copending application do not specifically teach forming the metal oxide interconnected nanoparticles as part of a photovoltaic device.

Nakamura prepares a photovoltaic cell by providing TiO₂ semiconductor particles on a substrate and firing (heating) the particles, and thus cross-linking the particles (see col. 5, lines 1-35; col. 7, lines 42-57; and Examples 1 and 2). In other words, TiO₂ semiconductor particles read on both the instant semiconductor particles and the instant cross-linking agent. The TiO₂ particles are thus, contacted with each other and then fired, as in instant claim 45.

With respect to claims 3-8, the interconnection of the particles is with the same material as the particles themselves, i.e., TiO₂, and the TiO₂ contains a metal to non-metal bond, i.e., a bond of Ti metal to O non-metal.

With respect to claims 11, 50, and 54, a dye can be applied to the semiconductor particles (see col. 7, line 66 through col. 8, line 29; and col. 33, line 66).

With respect to claims 12-14, see Figure 1 and Example 1 of Nakamura which show the instant substrates.

With respect to claims 15-18, 20-23, 48, 26, and 51, Nakamura's substrates can be flexible and transparent, and made from polymers such as polyethylene terephthalate, polyethylene naphthalate, or polyether-imide (which reads on the instant polyimide) (see col. 6, lines 4-21; and col. 14, lines 44-65).

With respect to claims 19, 44, and 53, the firing of the semiconductor particles can be at 100°C to 600°C, the 100°C being anticipatory of the instant temperature (see col. 7, lines 42-47). Indeed, note Example 2 at col. 35 uses a temperature of 300°C.

With respect to claims 24 and 46, the photovoltaic cell further comprises a gelled electrolyte solution that includes the combination of I₂ and an iodide salt in a solvent, such as ethylene carbonate, propylene carbonate, etc, and a gelling agent such as polyacrylonitrile, polyvinylidene fluoride, etc (thus forming a polymeric polyelectrolyte has here claimed) (see col. 25, lines 21-65; and col. 26, lines 16-32).

With respect to claims 49 and 55, Nakamura forms a Pt layer (6) which reads on the instant catalyst layer (see col. 34, line 21; and Figure 1).

The advantage of preparing a photovoltaic device is that electricity can be generated, and Nakamura's structure provides the advantage of excellent conversion efficiency (see col. 2, lines 24-26). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared a photovoltaic cell, such as

one having the structure of Nakamura, using the metal oxide interconnected nanoparticles in the claims of said copending application because the advantage of preparing a photovoltaic device is that electricity can be generated, and Nakamura's structure provides the advantage of excellent conversion efficiency.

This is a provisional obviousness-type double patenting rejection.

22. Claim 47 is provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-19 of copending Application No. 10/918,493 in view of Nakamura as applied to claims 1-25, 43-46, and 48-50 above, and further in view of Cao et al, "A Solid State Sensitized Photoelectrochemical Cell," J. Phys. Chem., vol. 99, pages 17071-17073, (1995).

The claims of said copending application, in view of Nakamura, as relied upon for the reasons recited above, teach the limitations of claim 47, the difference being that neither the claims of said copending application nor Nakamura teaches the electrolyte composition in said claim 47. Nakamura teaches an electrolyte in its cell (see col. 25, line 18 through col. 27, line 36). Cao et al is relied upon for showing a photoelectrochemical cell employing a dye-sensitized, nanocrystalline TiO_2 electrode and an electrolyte (see page 17071). The electrolyte is prepared from 1.4 g of polyacrylonitrile (PAN), 10 g of ethylene carbonate, 5 mL of propylene carbonate, 5 mL of acetonitrile, 1.5 g of NaI, and 0.1 g of I_2 (see the Experimental section). The ethylene carbonate, propylene carbonate, and acetonitrile together read on the instant plasticizer. The NaI/ I_2 reads on the instant redox electrolyte. Since the densities of propylene carbonate and acetonitrile are 1.2 g/mL and 0.79 g/mL respectively, then there are 6 g

of propylene carbonate and 3.95 g of acetonitrile. Thus, based on the total weight of polymer and plasticizer, there is 6.6% PAN and 93.4% plasticizer. The 1.5 g of NaI plus 0.1 g of I₂ in the 10 g ethylene carbonate, 5 mL propylene carbonate, and 5mL acetonitrile is within the instant range of 0.5M to about 10M of redox electrolyte. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Cao et al's electrolyte in the claims of said copending application in view of Nakamura's photovoltaic cell because Nakamura specifically teaches that an electrolyte is be used, and Cao et al's electrolyte is an example thereof.

This is a provisional obviousness-type double patenting rejection.

23. Claims 26 and 51-58 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-19 of copending Application No. 10/918,493 in view of Nakamura as applied to claims 1-25, 43-46, and 48-50 above, and further in view of Hoffmann et al, U.S. Patent 5,830,597.

The claims of said copending application, in view of Nakamura, as relied upon the reasons recited above, teach the limitations of instant claims 26 and 51-58, the difference being that Nakamura specifically teaches a continuous process for preparing the photovoltaic cell. However, the use of continuous processing is well known in the art, as shown in Figure 2 of Hoffmann et al (see also col. 4, line 18 through col. 5, line 52). In Hoffmann et al's process, the TiO₂ (8), dye (9), and electrolyte layer (10) are disposed on a first substrate (5) in a continuous process (see said Figure 2; and col. 4, lines 30-62). The second substrate (6) can be provided with the electrically conductive layer (11) (see col. 4, lines 36-40). Hoffmann et al's method provides the advantage of

producing a photovoltaic cell at low cost and with reproducibility (see col. 1, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared the photovoltaic cell of the claims of said copending application in view of Nakamura using continuous processing because such processing is conventional in the art, as shown by Hoffmann et al, and provides the advantage of producing a photovoltaic cell at low cost and with reproducibility, as taught by Hoffmann et al. While Hoffmann et al does not specifically teach the Pt catalyst layer in instant claim 26, this layer, as noted above, is taught by Nakamura.

This is a provisional obviousness-type double patenting rejection

Conclusion

24. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

It should be noted that parent U.S. application Serial No. 10/165,877 is assigned to both the University of Massachusetts Lowell and the US Army. The instant Application does not yet have a recorded assignee.

The following U.S. documents do not have an inventor in common with the instant Application, and have a different assignee (Konarka Technologies) from said parent application: 2004/0025933, 2004/0025934, 6,706,963.

US 2003/0056821 has a common inventor (Jin-An He) with the instant application, but has a different assignee (Konarka Technologies) from the instant parent application. The Examiner has considered method claims 34-50 in Serial No.

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10/350,919 (from which said US 2003/0056821 has published), but does not deem there to be any provisional obviousness-type double patenting.

US 2003/0188777 has published from the instant parent application.

Koyanagi et al, US 6,580,026, is of the same family as Koyanagi et al, WO 01/03232.

25. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alan Diamond whose telephone number is 571-272-1338. The examiner can normally be reached on Monday through Friday, 5:30 a.m. to 2:00 p.m. ET.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Alan Diamond
Primary Examiner
Art Unit 1753

Alan Diamond
December 7, 2004

